EMB190 Alerting Issues – In-flight cargo fire/smoke

1. Initiating Condition: Ignition of cargo leading to extinguishable belly cargo compartment fire, in cruise flight

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Flashing red "CRG (FWD or AFT) SMOKE" EICAS warning message	Smoke detected in cargo compartment			Alert can be suppressed by fire damage to the fire detection system, but failure of all fire detectors in a compartment is separately annunciated with the flashing amber "CRG (FWD or AFT) FIRESYS FAIL" EICAS caution message	Flashing terminated by pressing a Master Warning reset pushbutton; alert terminated when the fire detection system assesses that the fire has been extinguished
	Flashing cyan "CRG (FWD or AFT) FIREX HI ARM" EICAS advisory message	Extinguisher armed as a result of smoke detected in cargo compartment			Alert can be suppressed by fire damage to the fire detection system, but failure of all fire detectors in a compartment is separately annunciated with the flashing amber "CRG (FWD or AFT) FIRESYS FAIL" EICAS caution message	Advisory message is removed when smoke is no longer detected
	Red extinguishing button for the respective cargo compartment illuminates on the overhead panel	Smoke detected in cargo compartment			Alert can be suppressed by fire damage to the fire detection system, but failure of all fire detectors in a compartment is separately annunciated with the flashing amber "CRG (FWD or AFT) FIRESYS FAIL" EICAS caution message	
Aural Alerts	Fire Bell	Smoke detected in cargo compartment			Alert can be suppressed by fire damage to the fire detection system, but failure of all fire detectors in a compartment is separately annunciated with the flashing amber "CRG (FWD or AFT) FIRESYS FAIL" EICAS caution message	Cancelled by pressing a Master Warning reset pushbutton

EMB190 Alerting Issues – In-flight cargo fire/smoke

1. Initiating Condition: Ignition of cargo leading to extinguishable belly cargo compartment fire, in cruise flight – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Aural Alerts	Repetitive triple chime	Triggered by EICAS level 3 warning			Alert can be suppressed by fire damage to the fire detection system, but failure of all fire detectors in a compartment is separately annunciated with the flashing amber "CRG (FWD or AFT) FIRESYS FAIL" EICAS caution message	Cancelled by pressing a Master Warning reset pushbutton
Tactile Alerts	None					
Visual Cues	None					
Aural Cues	Possible reports from flight attendants or cargo supernumeraries about hot floor surfaces, presence of smoke or fumes, other evidence of fire/overheat	(No specific threshold; depends on flight attendants' inquisitiveness, persistence, communications abilities, as well as pilots' skills in prompting flight attendant investigation/communication)				
Tactile/ Somatic Cues	None					

EMB190 Alerting Issues – In-flight cargo fire/smoke

1. Initiating Condition: Ignition of cargo leading to extinguishable belly cargo compartment fire, in cruise flight – Cont.

Expected Pilot Response(s)

- Perform the appropriate CRG (FWD or AFT) SMOKE QRH procedure.
- As suggested in the CRG SMOKE QRH procedure, perform the Smoke/Fire/Fumes QRH procedure if required
- Land at nearest suitable airport (or sooner if necessary)
- Verify fire has been extinguished considering any continued smoke indications and any indications of fire detection system failure
- Advise ground personnel that halon has been discharged and not to open cargo compartments without prior clearance from ARFF.

Possible sources of confusion with regard to pilot response(s)

- History of false fire/smoke detector alarms can cause pilots to downplay or discount a valid warning
- Difficult/impossible to distinguish with certainty an active fire from minor or leftover smoke, or from a false alarm caused by dust or other triggers
- Even once the pilots know that a fire situation is ongoing, they do not necessarily know the seriousness of the situation, the future course of the fire, or the time available for continued safe flight. Consequently, they will have difficulty projecting the best course of action and the time available for implementing it.

How does pilot know condition is resolved/recovered?

- Previously illuminated cargo smoke indications are extinguished (however, may not extinguish due to residual smoke)
- Situation is not fully resolved until the aircraft has been returned to the ground and the ARFF response has been applied to the involved compartment and (if necessary) the aircraft has been evacuated

Issues with regard to multiple concurrent non-normal conditions

- Warnings/alerts/cues of other system failures (e.g., electrical, pneumatic, hydraulic) may be presented if these systems or associated detectors receive fire damage; these indications may distract the pilots' attention from responding to the primary fire situation or mask the primary situation
- On the other hand, these secondary failures may require additional responses by the pilots, and the optimal prioritization of pilot response to these multiple cues may be unclear

2. Initiating Condition: Dust/moisture leading to false indication of smoke in a cargo compartment, in cruise flight

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Flashing red "CRG (FWD or AFT) SMOKE" EICAS warning message	Smoke falsely detected in cargo compartment	False alarm (no actual fire or smoke) will present the same alerts as an actual fire			Flashing terminated by pressing a Master Warning reset pushbutton; alert terminated when the fire detection system assesses that the fire has been extinguished
	Flashing cyan "CRG (FWD or AFT) FIREX HI ARM" EICAS advisory message	Extinguisher armed as a result of smoke falsely detected in cargo compartment	False alarm (no actual fire or smoke) will present the same alerts as an actual fire			Advisory message is removed when smoke is no longer detected
	Red extinguishing button for the respective cargo compartment illuminates on the overhead panel	Smoke falsely detected in cargo compartment	False alarm (no actual fire or smoke) will present the same alerts as an actual fire			
Aural Alerts	Fire Bell	Smoke falsely detected in cargo compartment	False alarm (no actual fire or smoke) will present the same alerts as an actual fire			Cancelled by pressing a Master Warning reset pushbutton
	Repetitive triple chime	Triggered by false EICAS level 3 warning	False alarm (no actual fire or smoke) will present the same alerts as an actual fire			Cancelled by pressing a Master Warning reset pushbutton
Tactile Alerts	None					
Visual Cues	None					

EMB190 Alerting Issues – In-flight cargo fire/smoke

2. Initiating Condition: Dust/moisture leading to false indication of smoke in a cargo compartment, in cruise flight – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Aural Cues	Some indication may be available that alarm is false, though extremely ambiguously, from negative reports from flight attendants or cargo supernumeraries about hot floor surfaces, presence of smoke or fumes, other evidence of fire/overheat	(No specific threshold; depends on flight attendants' inquisitiveness, persistence, communications abilities, as well as pilots' skills in prompting flight attendant investigation/communication)				
Tactile/ Somatic Cues	None					

Expected Pilot Response(s)

- If the fire warning can be ascertained to be false, refrain from performing the cargo fire procedure; otherwise perform the procedure
- If the fire warning terminates after performing the procedure and can be ascertained to have been false, continue the flight; otherwise land within the specified time limit
- Unless the fire warning can be ascertained to be false, if the fire warning system indicates that the fire has **not** been extinguished after performing the procedure, land immediately
- Unless the fire warning can be ascertained to be false, advise ground personnel not to open cargo compartments without prior clearance from ARFF.

Possible sources of confusion with regard to pilot response(s)

- Difficult/impossible to distinguish with certainty an active fire from minor or leftover smoke, or from a false alarm caused by dust or other triggers
- As pilots consider that a fire situation is ongoing (despite the fact that it is not), they also have difficulty projecting the best course of action and the time available for implementing it.

How does pilot know condition is resolved/recovered?

- Previously illuminated cargo smoke indications are extinguished (however, may not extinguish due to residual smoke)
- Situation is not fully resolved until the aircraft has been returned to the ground and the ARFF response has been applied to the involved compartment, assessing and communicating to the pilots that the fire warning was false.